105

PATENT SPECIFICATION

747,667

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COMPLETE SPECIFICATION

Pressure Relief Valve

I, THOMAS HINDMARCH, of Lindo Lodge, Stanley Avenue, Chesham, Buckinghamshire, a British subject, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to pressure relief valves for fluid pressure systems.

Relief valves are often fitted to fluid pressure systems when it is necessary to keep the pressure in the system substantially constant despite varying delivery to it and varying drains from it. A common form of relief valve consists of a ball suitably guided and spring loaded onto a conical seat. With this type of valve it is usually difficult to maintain the pressure constant with any degree of accuracy, since the spring must be fairly rigid, and consequently the load changes considerably with small movements of the ball, and the area on which the fluid operates varies according to how far the ball is off its seat. This frequently leads to bounce of the ball, causing rapid fluctuations in pressure and early failure. Also the presence of small particles of foreign matter prevents the valve closing properly.

Many variations of this type of valve have been proposed and used, but all suffer from one or more of the above disadvantages to a greater or lesser degree.

The object of my invention is to provide a relief valve which will be stable in operation and will eliminate the above disadvantages, maintain the pressure constant within a very close limit, and which will, at the same time, be suitable for adjustment by remote control and/or can give one or more preset pressures according to the sequence of operation required.

The invention consists in a fluid pressure relief valve comprising a cylinder adapted for connection at or towards one end to a source of fluid pressure, a cup-like piston working in the cylinder and having its head remote from the source of fluid pressure, port means in the cylindrical wall of the piston for passage of fluid from the interior to the exterior of the same, an annular groove-like fluid channel in the inner periphery of said cylinder positioned such as to provide with the port means in the piston passage means of variable cross sectional area with longitudinal movement of the piston and which is closed with extreme motion of the piston towards the source of pressure fluid and helical spring means in the cylinder and acting upon the head of the valve to urge it towards the source of pressure fluid to close said port means and abuting at its end remote from the piston upon an abutment member, said member and the cylinder being movable relative to one another to adjust the working characteristics of the valve.

The invention further consists in a construction as set forth in the preceding paragraph in which the port means are bores at an angle other than a right angle to the axis of the piston.

My valve consists preferably in a hollow piston through the walls of which a series of holes are drilled at an angle. This slides in a sleeve in which is formed an annular groove from which holes pass to the outside of the sleeve and connect with a gallery for drainage to a sump.

The accompanying drawings show, by way of example only, three embodiments of the invention, in which

Figure 1 is a cross section of a simple form of valve,

Figure 2 is a cross section of valve having means to vary its characteristics, and

Figure 3 is a cross section of a further valve having means to vary its characteristics.

The hollow piston A in Figure 1 has holes B drilled at an angle in its walls. This piston slides in sleeve C in which the annular groove D is formed, which latter connects with the gallery F via holes E, which may be drilled at any convenient angle. The spring G bears

on the head of piston A, and since it is well guided by sleeve C, it may be of slender proportions, and thus be made very sensitive. Due to the holes B being at an angle, the aperture presented at the port on the outside of the piston is elongated, so that when the valve starts to open there is only a very small area exposed, but this increases rapidly with further slight movements of the piston.

It can be seen that as the fluid in the pressure gallery J always acts on the same area as the valve opens, and, as the spring can be made so that there is a considerable movement for a small change in load, the pressure can be held within very close limits without tendency to rapid fluctuations.

The outer end of the spring G in the embodiment shown bears on screw H which may be used for setting the required pressure characteristic of the valve. Alternatively, means may be provided in which this screw is fixed and the position of sleeve C varied for adjustment of the valve.

In Figure 2 there is shown a controlled pressure relief valve in which liquid or air pressure is used to modify the operating characteristics of the valve. The liquid pressure gallery J communicates with a pressure liquid operated machine and the pressure relief valve communicates between this gallery and the venting gallery F. The valve A which is similar to that described in reference to Figure 1 is held closed by the spring G under the action of the piston K working in the cylinder L. The piston is urged to move in the direction of the valve by the spring M, adjustable as to compression by means of the adjusting screw N.

An independent supply of compressed fluid is fed by way of a control valve (not shown) to the underside of the piston by way of the port O. When pressure is admitted through the port, for example with compressed air, at the time of starting of the machine in which the device is fitted, the relief pressure of the valve A is reduced by the lifting action of the air upon the piston K and contrary to the spring M. By this means the pressure in the gallery J is reduced for such time as the control valve allows pressure to be directed to the port O.

The sleeve C is movable by means of the screw P and controls the minimum pressure obtainable, while the screw N controls the maximum pressure obtainable.

Figure 3 shows a further embodiment in which the valve A controls the flow of fluid from the pressure gallery J to the venting gallery F. The controlling pressure is admitted above the piston K and increases the pressure on the spring G and so upon the valve A. The pressure air is supplied via the pipe Q to the two-position three-way valve R, which either supplies pressure to the system, or vents the system to atmosphere. The passage ways to the piston K are constituted by a metering valve S and a non-return valve T, by which the rate at which the piston K is depressed is controlled in one direction, while it is free to rise quickly by reason of the provision of the non-return valve when the pressure is released. The minimum pressure is adjusted by varying the screw N while the maximum is adjusted by the stops P, P.

The control of the characteristics may be hydraulic, pneumatic, or mechanical, and can be connected to other parts of the mechanism to which the valve is fitted so that the pressure can be varied according to the sequence of operations being carried out in the mechanism. Furthermore, a dashpot may be incorporated which will control the rate of change of characteristics of the valve with change of adjustment or change of pressure. Alternatively or simultaneously the position of the sleeve C may be varied by fluid pressure or mechanical means.

When the set pressures required differ widely, the simple spring may be replaced by a series of springs which come into operation sequentially, and at the same time the position of the sleeve C may be varied manually or automatically to provide accurate control at each set pressure.

While this relief valve is primarily intended to be used for maintaining constant pressure, it may be modified by the inclusion of a dashpot for the purpose of giving reduced starting pressure and other details for carrying the invention into effect may be varied without departing from the scope of the invention claimed.

What I claim is:—

1. Fluid pressure relief valve comprising a cylinder adapted for connection at or towards one end to a source of fluid pressure, a cup-like piston working in the cylinder and having its head remote from the source of fluid pressure, port means in the cylindrical wall of the piston for passage of fluid from the interior to the exterior of the same, an annular groove-like fluid channel in the inner periphery of said cylinder positioned such as to provide with the port means in the piston passage means of variable cross sectional area with longitudinal movement of the piston and which is closed with extreme motion of the piston towards the source of pressure fluid and helical spring means in the cylinder and acting upon the head of the valve to urge it towards the source of pressure fluid to close said port means and abutting at its end remote from the piston upon an abutment member, said member and the cylinder being movable relative to one another to adjust the working characteristics of the valve.

2. Fluid pressure relief valve as claimed in Claim 1 in which the port means are bores at an angle other than a right angle to the axis of the piston.

3. Fluid pressure relief valve as claimed in Claim 1 in which the abutment member is a plug and the cylinder is a cylindrical sleeve working in an outer cylindrical casing in which the plug is movable longitudinally.

4. Fluid pressure relief valve as claimed in Claim 3 in which the plug is screw threaded within the cylindrical casing.

5. Fluid pressure relief valve as claimed in Claim 3 in which remote control means is provided for moving the plug longitudinally of the cylindrical casing.

6. Fluid pressure relief valve as claimed in Claim 5 in which the plug is a control piston which works in a cylinder coaxial with the valve and is caused to move towards the valve by fluid pressure between this piston and an end wall to its cylinder.

7. Fluid pressure relief valve as claimed in Claim 5 in which the plug is a control piston which works in a cylinder coaxial with the valve and is caused to move away from the valve against the action of a spring by fluid pressure between this piston and an end wall of its cylinder.

8. Fluid pressure relief valve as claimed in Claim 7 in which the compression of the spring is adjustable.

9. Fluid pressure relief valve as claimed in Claim 6 in which the operating fluid passes to the cylinder of the control piston by way of a two-position three-way valve in which in the one position the fluid passes to the cylinder from a source of pressure by way of a metering valve and in the other position is discharged from the said cylinder to atmosphere via a non-return valve.

10. Fluid pressure relief valve as claimed in Claim 6 in which adjustable stops are provied to control the distance of travel of the said control piston towards the valve.

11. Fluid pressure relief valve as claimed in Claim 3 in which means is provided for moving the cylindrical sleeve in the cylindrical casing.

12. Fluid pressure relief valve as claimed in Claim 1 in which dashpot means is provided for controlling the rate of movement of the piston in its cylinder.

13. Fluid pressure relief valve as claimed in Claim 1 in which dashpot means is provided for controlling the rate of relative movement between the abutment member and the cylinder.

14. Fluid pressure relief valve substantially as hereinbefore described and as shown in Figure 1 of the accompanying drawings.

15. Fluid pressure relief valve substantially as hereinbefore described and as shown in Figure 2 of the accompanying drawings.

16. Fluid pressure relief valve substantially as hereinbefore described and as shown in Figure 3 of the accompanying drawings.

MARKS & CLERK.

PROVISIONAL SPECIFICATION

Pressure Relief Valve

I, THOMAS HINDMARCH, of Lindo Lodge, Stanley Avenue, Chesham, Buckinghamshire, a British subject, do hereby declare this invention to be described in the following statement: —

Relief valves are often fitted to fluid pressure systems when it is necessary to keep the pressure in the system substantially constant despite varying delivery to it and varying drains from it. A common form of relief valve consists of a ball suitably guided spring loaded onto a conical seat. With this type of valve it is usually difficult to maintain the pressure constant with any degree of accuracy, since the spring must be partly rigid and consequently the load changes considerably with small movements of the ball, and the area on which the fluid operates varies according to how far the ball is off its seat. This frequently leads to bounce of the ball, causing rapid fluctuations in pressure and early failure. Also the presence of small particles of foreign matter prevent the valve closing properly.

Many variations of this type of valve have been proposed and used, but all suffer from one or more of the above disadvantages to a greater or lesser degree.

The object of my invention is to provide a relief valve which will be stable in operation and will eliminate the above disadvantages, maintain the pressure constant within a very close limit, and which will, at the same time, be suitable for adjustment by remote control and/or can give one or more preset pressures according to the sequence of operation required.

The invention consists in a fluid pressure relief valve comprising a cup-like piston working in a cylinder, said piston being provided with a port or ports in the wall thereof in co-operation with an annular ring-like fluid channel in the wall of the cylinder, said piston being urged longitudinally of the cylinder by a spring acting upon the head of the piston to close said port or ports against the pressure of the operating fluid.

The invention further consists in a construction as set forth in the preceding paragraph in which the ports in the piston are bores at an angle other than a right angle to the axis of the piston.

The invention still further consists in a con-

struction as set forth in either of the preceding paragraphs in which the spring means abuts a movable member remote from the piston which is adjustable longitudinally of the cylinder directly or indirectly to change the working characteristics of the valve.

The invention still further consists in a construction as set forth in the preceding paragraph in which the rate of change of character of the valve is controlled by a dashpot.

My valve consists preferably in a hollow piston through the walls of which a series of holes are drilled at an angle. This slides in a sleeve in which is formed an annular groove from which holes pass to the outside of the tube and connect with the gallery for drainage to the sump.

In one form of my invention a hollow piston A has holes B drilled at an angle in its walls. This slides in sleeve C in which the annular ring D is formed which connects with gallery F via holes E, which may be drilled at any convenient angle. The spring G bears on the outer face of piston A and since it is well guided by sleeve C, it may be of slender proportions, and thus made very sensitive. Due to drilling the holes at an angle, the surface of the hole on the outside of the piston is elongated, so that when the valve starts to open there is only a very small area exposed, but this increases rapidly with further slight movements of the piston.

It can be seen that the pressure always acts on the same area, and, as the spring can be made so that there is a considerable movement for a small change in load, the pressure can be held within very close limits without tendency to rapid fluctuations.

The outer end of the spring G bears on screw H which may be used for setting the required pressure. Alternatively, this may be fixed and position of sleeve C varied for adjustment of pressure.

In an alternative design, the plug H is adapted to be moved by remote control. This may be hydraulic or pneumatic, or mechanical and can be connected to other parts of the mechanism so that the pressure can be varied according to the sequence of operations. Furthermore a dashpot may be incorporated which will control the rate of change of characteristics of the valve with change of adjustment or change of pressure.

Alternatively or simultaneously the position of the sleeve C may be varied.

When the set pressures required differ widely the simple spring may be replaced by a series of springs which come into operation sequentially, and at the same time the position of the sleeve C may be varied manually or automatically to provide accurate control at each set pressure.

While this relief valve will be used for maintaining constant pressure, it may be modified by the inclusion of a dashpot for the purpose of giving reduced starting pressure and other details for carrying the invention into effect may be varied without departing from the scope of the invention.

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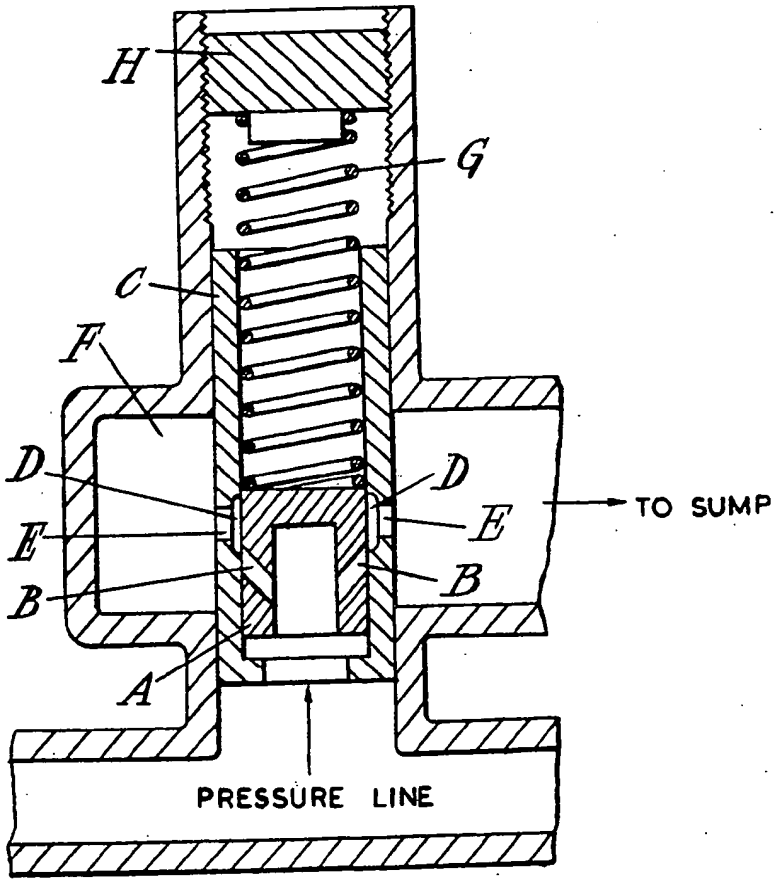
747,667 PROVISIONAL SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale.*



747,667 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

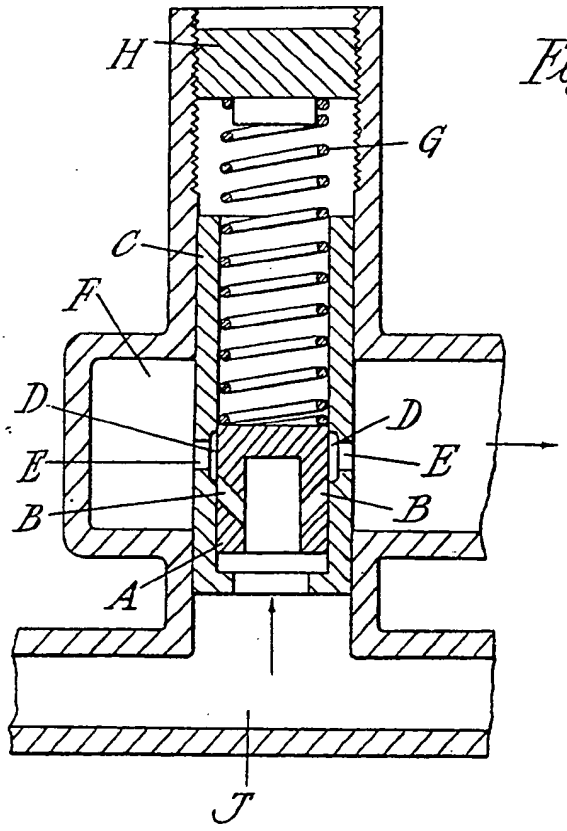


Fig. 1.

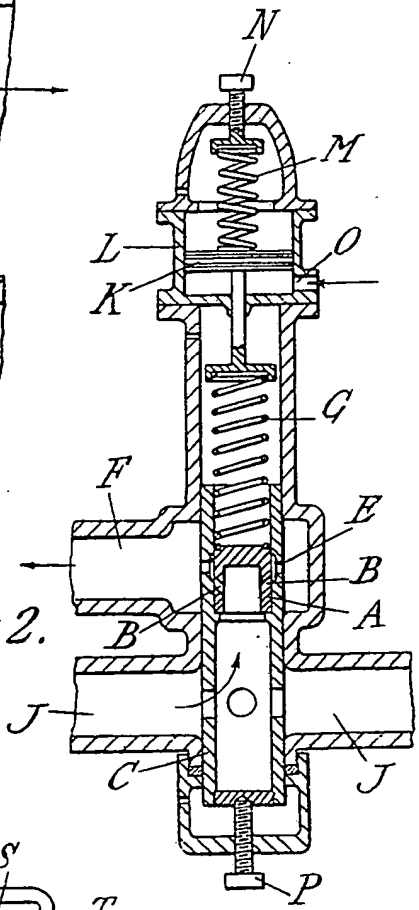


Fig. 2.

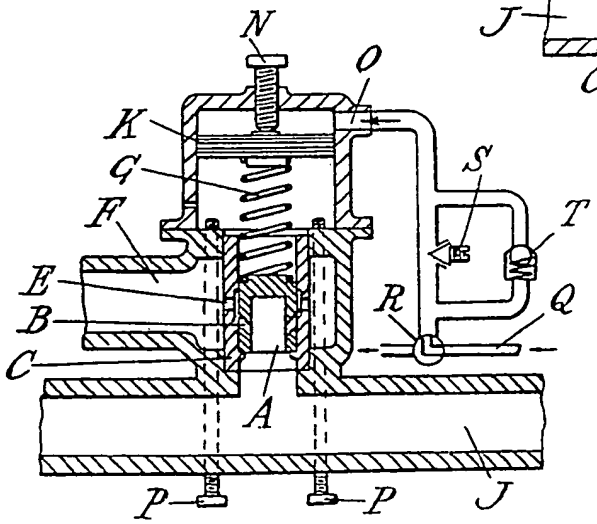


Fig. 3.